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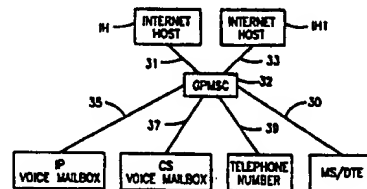
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(54) Title: PROCESSING PACKET-SWITCHED VOICE CALLS DIRECTED TO A MOBILE UNIT OPERATING IN CIRCUIT-SWITCHED MODE

(57) Abstract

A packet-switched voice call directed to a mobile subscriber unit (MS/DTE) in a cellular communication network is processed by determining whether the mobile subscriber unit is in a circuit-switched mode of operation (23) and, if so, either forwarding the information in the packet-switched voice call to a destination other than the mobile subscriber unit or notifying the mobile subscriber unit (B, C, D, E) that the packet-switched voice call is waiting (51).



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PROCESSING PACKET-SWITCHED VOICE CALLS DIRECTED TO A MOBILE UNIT OPERATING IN CIRCUIT-SWITCHED MODE

5 FIELD OF THE INVENTION

This invention relates generally to routing of communications in a cellular communication network and, more particularly, to routing of packet-switched voice calls directed to a mobile subscriber unit in a cellular communication network.

10 BACKGROUND OF THE INVENTION

FIGURE 1 illustrates the architecture of a conventional cellular communication network, for example the Personal Digital Cellular system. The mobile station or mobile subscriber unit MS is capable of conducting both circuit-switched communication and packet-switched communication in the cellular network. Moreover, the cellular network supports voice communication via circuit-switched connections and via packet switching. The mobile subscriber unit typically has a permanent address, for example an Internet Protocol (IP) address which is known by the network. The data terminal equipment (DTE) attached to the mobile subscriber unit is configured with the IP address.

20 When the Gateway Packet Mobile Services Switching Center (GPMSC) receives an incoming IP voice packet from the Internet Host IH via the Internet, GPMSC checks with the home location register HLR and the Visited Mobile Services Switching Center VMSC to see if the mobile subscriber unit MS to which the IP voice packet is directed is already busy in a circuit-switched (CS) call. The HLR tells
25 GPMSC whether or not the mobile subscriber unit is in the packet mode, and the VMSC tells the GPMSC whether the mobile subscriber unit is in CS mode or is idle. If it is determined that the mobile subscriber unit is already busy in a CS call, then the incoming IP voice packets directed to the mobile subscriber unit will be rejected. If, on the other hand, the mobile subscriber unit is not busy in a circuit-switched call, then
30 the GPMSC sets up a packet channel to MS/DTE, and an IP voice session between the Internet Host IH and the mobile subscriber unit can be established.

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Also shown in FIGURE 1 are a Visited Packet Mobile Services Switching Center VPMSC, a Gateway Mobile Services Switching Center GMSC, a Public Switched Telephone Network PSTN, an Integrated Services Digital Network ISDN, and a radio network, all well known components of a conventional cellular network architecture.

The above-described conventional operation of the GPMSC is illustrated in FIGURE 2. If an IP voice call is received at 21, it is determined at 23 whether or not the mobile station is busy in a circuit-switched call. If the mobile station is busy in a circuit-switched call, then the IP voice packets are rejected at 25. If the mobile station is not busy in a circuit-switched call at 23, then the GPMSC sets up a packet channel to MS/DTE, and an IP voice session between the Internet Host IH and the mobile subscriber unit can be established at 27.

It is desirable in view of the foregoing to process incoming packet-switched voice calls such that the voice packets are not rejected if the mobile subscriber unit to which they are directed is busy in a circuit-switched call.

According to the present invention, packet-switched voice calls directed to a mobile subscriber unit that is busy in a circuit-switched call are accommodated without rejecting the voice packets. Either the information in the packet-switched voice call is forwarded to a destination other than the mobile subscriber unit, or the mobile subscriber unit is notified that the packet-switched voice call is waiting.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 illustrates a conventional cellular communication network.

FIGURE 2 illustrates operations performed by the GPMSC of FIGURE 1.

FIGURE 3 is a block diagram which conceptually illustrates how a GPMSC according to the present invention processes packet-switched voice calls directed to a mobile subscriber unit that is busy in a circuit-switched call.

FIGURE 4 illustrates the operation of the GPMSC of FIGURE 3 when it receives a packet-switched voice call directed to a mobile subscriber unit.

FIGURE 5 illustrates one exemplary response of the GPMSC when the mobile subscriber unit is busy in FIGURE 4.

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FIGURE 6 illustrates one exemplary response of the GPMSC when the mobile subscriber unit is busy in FIGURE 4 or does not accept the call in FIGURE 5.

FIGURE 7 illustrates another exemplary response of the GPMSC when the mobile subscriber unit is busy in FIGURE 4 or does not accept the call in FIGURE 5.

5 FIGURE 8 illustrates another exemplary response of the GPMSC when the mobile subscriber unit is busy in FIGURE 4 or does not accept the call in FIGURE 5.

FIGURE 9 illustrates another exemplary response of the GPMSC when the mobile subscriber unit is busy in FIGURE 4 or does not accept the call in FIGURE 5.

10 FIGURE 10 illustrates one exemplary response of the GPMSC when the mobile subscriber unit accepts the call in FIGURE 5 in circuit-switched mode.

DETAILED DESCRIPTION

Example FIGURE 3 is a block diagram which illustrates the routing of packet-switched voice calls by a GPMSC 32 according to the present invention. The communication links at 30, 31, 33, 35, 37 and 39 are illustrated conceptually for clarity of exposition. A packet-switched voice call is received at an input of GPMSC 32 via one of the communication links. The GPMSC 32 responds to receipt of the call by providing at an output thereof a suitable communication to be carried, for example, by one of the communication links to one of the components shown in FIGURE 3. Workers in the art will readily comprehend from the following description the actual routing of communications in FIGURE 3.

15 The communication links at 30, 31, 33, 35, 37 and 39 are illustrated conceptually for clarity of exposition. A packet-switched voice call is received at an input of GPMSC 32 via one of the communication links. The GPMSC 32 responds to receipt of the call by providing at an output thereof a suitable communication to be carried, for example, by one of the communication links to one of the components shown in FIGURE 3.

20 Workers in the art will readily comprehend from the following description the actual routing of communications in FIGURE 3.

Referencing also exemplary FIGURE 4, if at 21 the GPMSC 32 receives at an input thereof a packet-switched voice call (in this example an IP voice call from Internet Host IH), it is first determined at 23 whether or not the mobile subscriber unit is busy in a circuit-switched call. If not, then at 27 the GPMSC 32 sets up a packet channel to MS/DTE, and an IP voice session between the Internet Host IH and the mobile subscriber unit can be established. This voice session is conducted via the GPMSC 32 and the communication links 31 and 30. It will be noted that the operations at 21, 23 and 27 in FIGURE 4 are the same as the correspondingly numbered operations in prior art FIGURE 2. Thus, when the mobile subscriber unit is not busy in a circuit-switched call, the GPMSC 32 responds to an incoming packet-

25 is busy in a circuit-switched call. If not, then at 27 the GPMSC 32 sets up a packet channel to MS/DTE, and an IP voice session between the Internet Host IH and the mobile subscriber unit can be established. This voice session is conducted via the GPMSC 32 and the communication links 31 and 30. It will be noted that the operations at 21, 23 and 27 in FIGURE 4 are the same as the correspondingly numbered operations in prior art FIGURE 2. Thus, when the mobile subscriber unit is not busy in a circuit-switched call, the GPMSC 32 responds to an incoming packet-

30 is not busy in a circuit-switched call, the GPMSC 32 responds to an incoming packet-

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switched voice call in the same manner as the prior art GPMSC described above with respect to exemplary FIGURES 1 and 2.

If at 23 the mobile subscriber unit is busy in a circuit-switched call, then the GPMSC 32 can respond by executing any one of five exemplary procedures designated at B, C, D, E and F in FIGURE 4.

The exemplary procedure designated at F in FIGURE 4 is the call waiting procedure of FIGURE 5. At 51 in the call waiting procedure, the GPMSC 32 notifies the mobile subscriber unit of the IP voice call. Use of a call-waiting notification is well known in the art. It is advantageous, however, to provide at the mobile subscriber unit a unique indication (e.g. audible) that enables the user to determine that the waiting call is a packet-switched voice call. The user of the mobile subscriber unit determines whether or not to accept the IP voice call. The decision of the user is transmitted to the GPMSC, and the GPMSC determines at 53 whether or not the user of the mobile subscriber unit has accepted the IP voice call. If not, then the GPMSC executes any one of the aforementioned procedures designated at B, C, D and E. If the user of the mobile subscriber unit accepts the IP call at 53, it is then determined at 55 whether the mobile subscriber unit has chosen to receive the IP voice call in circuit-switched mode or in packet-switched mode.

If circuit-switched mode is selected at 55, then the GPMSC executes the exemplary procedure designated at G in FIGURE 5. If packet-switched mode is selected, then the GPMSC sets up a packet channel to MS/DTE, and an IP voice session between the Internet Host IH and the mobile subscriber unit can be established (27). It will be noted that the IP voice session conducted at 27 in FIGURE 5 can be the same as the conventional IP voice session illustrated in FIGURES 2 and 4. After the IP voice session is completed at 27, the call waiting procedure of FIGURE 5 proceeds to point A of FIGURE 4 and thus re-enters the decision block 21 of FIGURE 4.

Exemplary FIGURE 6 illustrates the procedure designated at B in FIGURES 4 and 5. This procedure can be executed by GPMSC 32 when the mobile subscriber unit is busy in a circuit-switched call at 23 in FIGURE 4 or when the mobile subscriber unit does not accept the IP voice call at 53 in FIGURE 5. The procedure designated at B in FIGURES 4-6 is operative to set up and conduct an IP voice session

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between the Internet Host IH and an IP voice mailbox (see FIGURE 3). In FIGURE 6, the GPMSC alters the source and destination addresses in the IP voice packets that are exchanged between the Internet Host IH and the IP voice mailbox.

5 If it is determined at 61 that a packet arriving at the GPMSC 32 is from the Internet Host IH, then at 63 the GPMSC changes the destination address in that packet to the address of the IP voice mailbox, and also changes the source address of that packet to the address of DTE. It will be noted that the destination address which is received from the Internet Host IH, and which is changed at 63 to the IP voice mailbox address, is the DTE address. It will likewise be noted that the source address which
10 is received from the Internet Host IH, and which is replaced at 63 by the DTE address, is the address of the Internet Host IH. The destination address is changed to the IP voice mailbox address so that the packet is routed to the IP voice mailbox, and the source address is changed to the DTE address because the IP voice mailbox needs this address for identification of the mobile user. After the source address and destination
15 address are changed at 63, the packet is released at 65.

It is thereafter determined at 67 whether there are any more packets in the IP voice session. If so, then control returns to decision block 61. If not, then control proceeds to point A of FIGURE 4 and thus re-enters decision block 21 of FIGURE 4. If the GPMSC receives a packet from the IP voice mailbox at 61, then at 69 the
20 GPMSC 32 changes the destination address of that packet to the address of the Internet Host IH, and also changes the source address of that packet to the DTE address. It will be noted that a packet received at GPMSC 32 from the IP voice mailbox would have the DTE address for a destination address, and would have the IP voice mailbox address as a source address. These addresses supplied by the IP voice mailbox are
25 changed at 69 in order to facilitate the IP voice session between the IP voice mailbox and the Internet Host IH. After the addresses are changed at 69, the packet is released at 65 as described above.

It will be recognized from the foregoing description of FIGURE 6 that GPMSC acts as a proxy server, translating the IP source and destination addresses. The packets
30 received from the Internet Host IH have their destination addresses changed to permit them to be rerouted to the IP voice mailbox (instead of DTE), and also have their source addresses changed in order to permit the IP voice mailbox to identify them as

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packets associated with DTE. According to the invention, the IP voice mailbox may include, for example, a look-up table including the MS/DTE addresses of all mobile stations that use the IP voice mailbox. When the IP voice mailbox receives a voice packet, it can first compare the source address of the packet to the MS/DTE address entries in the table. If a matching MS/DTE address is found in the table, then the IP voice mailbox stores the packet in the mailbox associated with the matched MS/DTE address. If no match is found, the IP voice mailbox discards the packet. It should also be noted that the IP voice mailbox should preferably be physically closely connected to GPMSC 32, for example, closely enough that packets exchanged therebetween would not need to traverse the Internet.

It will also be appreciated that packets received at GPMSC from the IP voice mailbox have their destination addresses changed to permit them to be rerouted to the Internet Host IH (instead of DTE), and have their source addresses changed in order to permit the Internet Host IH to accept them as packets from DTE. The GPMSC 32 makes it appear to the IP voice mailbox that packets from the Internet Host IH are instead from DTE, and also makes it appear to the Internet Host IH that packets from the IP voice mailbox are instead from DTE. This address mapping operation facilitates the IP voice session between the Internet Host IH and the IP voice mailbox.

FIGURE 7 illustrates another exemplary response of the GPMSC 32 when the mobile subscriber unit is busy at 23 in FIGURE 4 or when the mobile subscriber unit does not accept the IP voice call at 53 in FIGURE 5. The procedure in FIGURE 7 is designated at C in FIGURES 4, 5 and 7. In FIGURE 7, the GPMSC 32 sets up and conducts an IP voice session between the Internet Host IH and the Internet Host IH1 (see FIGURE 3). If a packet is received from the Internet Host IH at 71, then the destination address and source address of that packet are changed at 73. In particular, the destination address of the packet is changed to the address of Internet Host IH1, and the source address of the packet is changed to the address of GPMSC 32. It will be noted that the destination address as originally received from the Internet Host IH would have been the DTE address, and the source address would have been the address of the Internet Host IH. After the addresses are changed at 73, the packet is released at 75. Thereafter at 77, the GPMSC determines whether or not there are any more packets to be routed in the IP voice session. If so, then the procedure re-enters

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decision block 71. If not, then the procedure moves to point A in FIGURE 4 to re-enter decision block 21 of FIGURE 4.

5 Packets received from Internet Host IH1 at 71 have their destination and source addresses changed at 79. More specifically, the destination address of such packets is changed to the address of the Internet Host IH, and the source address of such packets is changed to the address of DTE. It will be noted that the destination address of packets as received from Internet Host IH1 would be the address of GPMSC 32 and the source address of such packets would be the address of Internet Host IH1. After the addresses are changed at 79, the packet is released at 75 as described above.

10 It will be appreciated that the GPMSC acts as a proxy server in FIGURE 7, translating the IP addresses. By changing the addresses at 73 in FIGURE 7, the GPMSC 32 permits packets sent from Internet Host IH to DTE to be redirected by GPMSC to Internet Host IH1. The changing of addresses at 79 permits packets sent from the Internet Host IH1 to the GPMSC 32 to be forwarded from the GPMSC 32 to the Internet Host IH and to appear as though they originated at DTE. Thus, the address mapping procedures at 73 and 79 enable the GPMSC to conduct an IP voice session between the Internet Host IH and the Internet Host IH1.

20 FIGURE 8 illustrates another example response of the GPMSC when the mobile subscriber unit is busy at 23 in FIGURE 4 or the mobile subscriber unit does not accept the IP voice call at 53 in FIGURE 5. The procedure illustrated in FIGURE 8 is designated at D in FIGURES 4, 5 and 8. In FIGURE 8, the GPMSC sets up and conducts a conventional IP voice session between the Internet Host IH and the GPMSC, and also sets up and conducts a conventional CS voice session between the GPMSC and a conventional circuit-switched (CS) voice mailbox (see FIGURE 3).

25 At 81 in FIGURE 8, the GPMSC 32 translates or converts the IP voice packets received from the Internet Host IH into circuit-switched voice signals. The GPMSC sends the CS voice signals to the CS voice mailbox. At 83, the GPMSC 32 translates or converts CS voice signals received from the CS voice mailbox into IP voice packets, and sends the IP voice packets to the Internet Host IH. It will be recognized from the procedures at 81 and 83 that the GPMSC 32 operates in FIGURE 8 as a
30 conventional IP Voice Gateway. If the call is not finished at 85, then the procedure

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returns to re-enter block 81. If the call is finished at 85, then the procedure moves to point A in FIGURE 4 to re-enter decision block 21 of FIGURE 4.

FIGURE 9 illustrates another example response of the GPMSC 32 when the mobile subscriber unit is busy at 23 in FIGURE 4 or the mobile subscriber unit does not accept the IP voice call at 53 in FIGURE 5. The procedure of FIGURE 9 is designated at E in FIGURES 4, 5 and 9. In FIGURE 9, the GPMSC 32 sets up and conducts an IP voice session between the Internet Host IH and the GPMSC, and also sets up and conducts a CS voice session between the GPMSC and a conventional telephone number (see FIGURE 3). The procedures at 91 and 93 in FIGURE 9 are analogous to the procedures at 81 and 83 in FIGURE 8, the CS voice session in FIGURE 9 being conducted between the GPMSC and the telephone number rather than between the GPMSC and the CS voice mailbox as in FIGURE 8. The communication link 39 between GPMSC 32 and the telephone number can include, for example, a PSTN or ISDN network or a radio network (see FIGURE 1).

FIGURE 10 illustrates an example of the response of the GPMSC 32 when the mobile subscriber unit accepts the IP voice call but chooses the CS mode in FIGURE 5. The procedure in FIGURE 10 is designated at G in FIGURES 5 and 10. In FIGURE 10, the GPMSC sets up and conducts an IP voice session between the Internet Host IH and the GPMSC, and also sets up and conducts a CS voice session between the GPMSC and the mobile subscriber unit MS. The procedures indicated at 101 and 103 in FIGURE 10 are analogous to those indicated at 81 and 83 in FIGURE 8 and those indicated at 91 and 93 in FIGURE 9, the CS voice session in FIGURE 10 being conducted between the GPMSC and the mobile subscriber unit MS.

It will thus be appreciated that the GPMSC 32 acts in FIGURE 8 as a conventional IP Voice Gateway between the Internet Host IH and the CS voice mailbox, and acts in FIGURE 9 as a conventional IP Voice Gateway between the Internet Host IH and the telephone number, and acts in FIGURE 10 as a conventional IP Voice Gateway between the Internet Host IH and the mobile subscriber unit MS/DTE.

According to the foregoing description, an IP voice call received from Internet Host IH and directed to the mobile subscriber unit MS and data terminal equipment DTE at MS/DTE can be redirected to an IP Voice Mailbox (FIGURE 6) or to another

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Internet Host IH1 (FIGURE 7). Further, the GPMSC can be operated as an IP Voice Gateway between the Internet Host IH and a circuit-switched voice mailbox (FIGURE 8) or between the Internet Host IH and a telephone number (FIGURE 9). In each of FIGURES 6-9, the information in an IP voice call directed to the mobile subscriber unit is redirected or forwarded instead to a destination other than the mobile subscriber unit. These redirecting operations of FIGURES 6-9 may be employed when the mobile subscriber unit is busy at 23 in FIGURE 4 or when the mobile subscriber unit does not accept the IP voice call at 53 in FIGURE 5.

If the call waiting procedure of FIGURE 5 is executed after determining that the mobile station is busy at 23 in FIGURE 4, then any of the operations of FIGURES 6-9 may be selected if the mobile subscriber unit does not accept the IP voice call at 53. If the IP voice call is accepted at 53, and if the mobile subscriber unit chooses the circuit-switched mode, then the GPMSC 32 acts as an IP Voice Gateway between the Internet Host IH and the mobile subscriber unit MS/DTE as illustrated in FIGURE 10. If the IP voice call is accepted for packet mode delivery at 55, then a conventional IP voice session is set up and conducted between IH and MS/DTE.

The present invention thus provides for processing a packet-switched voice call when the mobile subscriber unit is busy in a circuit-switched voice call, and does not require rejection of the packet-switched voice call.

All IP voice sessions described above are set up using well-known conventional techniques such as described in ITU-T (Telecommunication Standardization Sector of the International Telecommunication Union) Recommendation H.323 (11/96), which is hereby incorporated herein by reference. All CS voice sessions described above are readily set up using well-known conventional telephony techniques such as promulgated by ITU-T.

It will be evident to workers in the art that GPMSC 32 of FIGURES 3-10 can, in one example approach, be readily realized by appropriately modifying the software in the conventional GPMSC of FIGURES 1-2. Other suitable combinations of hardware and software modifications in the conventional GPMSC will also suffice to realize GPMSC 32, as will be evident to workers in the art in view of the foregoing description.

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Although exemplary embodiments of the present invention have been described above in detail, this does not limit the scope of the invention, which can be practiced in a variety of embodiments.

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WHAT IS CLAIMED IS:

1. A method of processing a packet-switched voice call directed to a mobile subscriber unit in a cellular communication network, comprising:

determining that the mobile subscriber unit is in a circuit-switched mode of operation; and

forwarding the information in the packet-switched voice call to a destination other than the mobile subscriber unit.

2. The method of Claim 1, wherein said forwarding step includes forwarding the packet-switched voice call to a packet-switched voice mailbox.

3. The method of Claim 1, wherein said forwarding step includes forwarding the information in the packet-switched voice call to a circuit-switched voice mailbox.

4. The method of Claim 1, wherein said forwarding step includes forwarding the packet-switched voice call to an Internet Host.

5. The method of Claim 1, wherein said forwarding step includes forwarding the information in the packet-switched voice call to a telephone number.

6. The method of Claim 1, wherein said forwarding step includes conducting a packet-switched voice session between a source of the packet-switched voice call and a GPMSC, and conducting a circuit-switched voice session between the GPMSC and the destination.

7. The method of Claim 6, wherein said last-mentioned conducting step includes using the GPMSC to convert the packet-switched voice call into a circuit-switched voice call.

8. The method of Claim 7, wherein the destination is a circuit-switched voice mailbox.

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9. The method of Claim 7, wherein the destination is a telephone number.
10. The method of Claim 7, wherein the source is an Internet Host.
- 5 11. The method of Claim 1, wherein said forwarding step includes conducting a packet-switched voice session between a source of the packet-switched voice call and the destination.
- 10 12. The method of Claim 11, wherein said conducting step includes changing a destination address of a voice packet that is enroute from the source to the destination.
- 15 13. The method of Claim 11, wherein said conducting step includes changing a source address of a voice packet that is enroute from the source to the destination.
- 20 14. The method of Claim 13, wherein said conducting step includes changing a destination address of a voice packet that is enroute from the source to the destination.
- 25 15. The method of Claim 14, wherein said changing steps include using a GPMSC to change the addresses.
- 30 16. The method of Claim 15, wherein the source is an Internet Host.
17. The method of Claim 16, wherein the destination is a packet-switched voice mailbox.
18. The method of Claim 16, wherein the destination is a further Internet Host.

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19. The method of Claim 11, wherein said conducting step includes changing a destination address of a voice packet that is enroute from the destination to the source.

5 20. The method of Claim 11, wherein said conducting step includes changing a source address of a voice packet that is enroute from the destination to the source.

10 21. The method of Claim 20, wherein said conducting step includes changing a destination address of a voice packet that is enroute from the destination to the source.

 22. The method of Claim 21, wherein said changing steps include using a GPMSC to change the addresses.

15 23. The method of Claim 22, wherein the source is an Internet Host.

 24. The method of Claim 23, wherein the destination is a packet-switched voice mailbox.

20 25. The method of Claim 23, wherein the destination is a further Internet Host.

25 26. A method of processing a packet-switched voice call directed to a mobile subscriber unit in a cellular communication network, comprising:
 determining that the mobile subscriber unit is in a circuit-switched mode of operation; and
 notifying the mobile subscriber unit of the packet-switched voice call.

30 27. The method of Claim 26, including determining that the mobile subscriber unit has accepted the packet-switched voice call, and thereafter conducting

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a packet-switched voice session between the mobile subscriber unit and a source of the packet-switched voice call.

5 28. The method of Claim 26, including determining that the mobile subscriber unit has accepted the packet-switched voice call, and thereafter converting the packet-switched voice call into a circuit-switched voice call to the mobile subscriber unit.

10 29. The method of Claim 28, wherein said converting step includes receiving voice packets at a GPMSC, and outputting from the GPMSC the circuit-switched voice call to the mobile subscriber unit.

15 30. The method of Claim 26, including determining that the mobile subscriber unit has rejected the packet-switched voice call, and thereafter forwarding the information in the packet-switched voice call to a destination other than the mobile subscriber unit.

20 31. The method of Claim 30, wherein said forwarding step includes forwarding the packet-switched voice call to a packet-switched voice mailbox.

 32. The method of Claim 30, wherein said forwarding step includes forwarding the information in the packet-switched voice call to a circuit-switched voice mailbox.

25 33. The method of Claim 30, wherein said forwarding step includes forwarding the packet-switched voice call to an Internet Host.

30 34. The method of Claim 30, wherein said forwarding step includes forwarding the information in the packet-switched voice call to a telephone number.

 35. The method of Claim 1, wherein the packet-switched voice call is an IP voice call.

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36. The method of Claim 26, wherein the packet-switched voice call is an IP voice call.

5 37. A switching apparatus for processing information in a packet-switched voice call directed to a mobile subscriber unit of a cellular communication network, comprising:

an input for receiving the packet-switched voice call;

a further input for receiving information indicative of whether the mobile subscriber unit is busy in a circuit-switched voice call; and

10 an output through which the information in the packet-switched voice call is forwarded to a destination other than the mobile subscriber unit if the mobile subscriber unit is busy in a circuit-switched voice call.

15 38. The apparatus of Claim 37, wherein the packet-switched voice call is an IP voice call.

39. A switching apparatus for processing information in a packet-switched voice call directed to a mobile subscriber unit of a cellular communication network, comprising:

20 an input for receiving the packet-switched voice call;

a further input for receiving information indicative of whether the mobile subscriber unit is busy in a circuit-switched voice call; and

25 an output through which the mobile subscriber unit is notified that the packet-switched voice call is waiting if the mobile subscriber unit is busy in a circuit-switched voice call.

40. The apparatus of Claim 39, wherein the packet-switched voice call is an IP voice call.

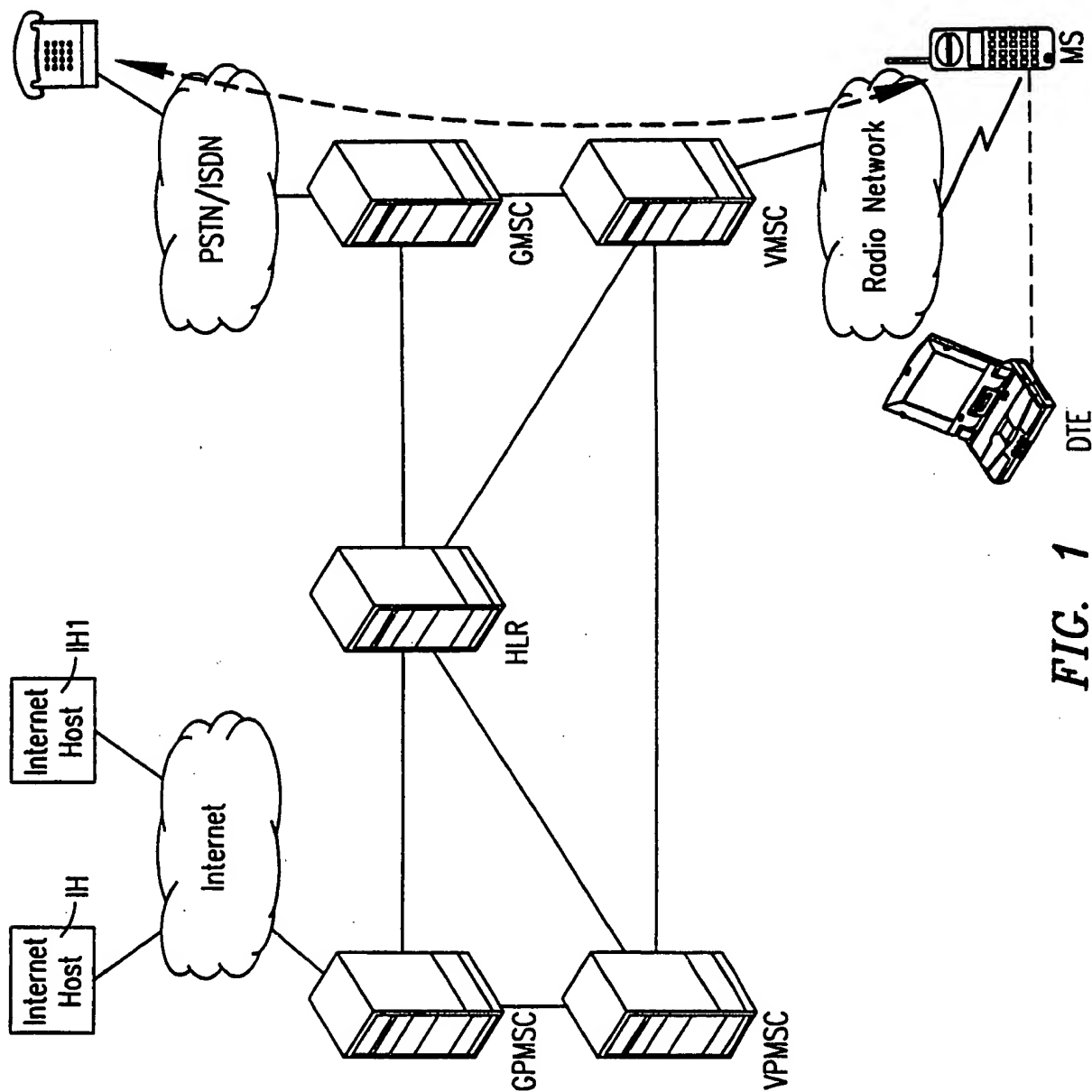


FIG. 1
(PRIOR ART)

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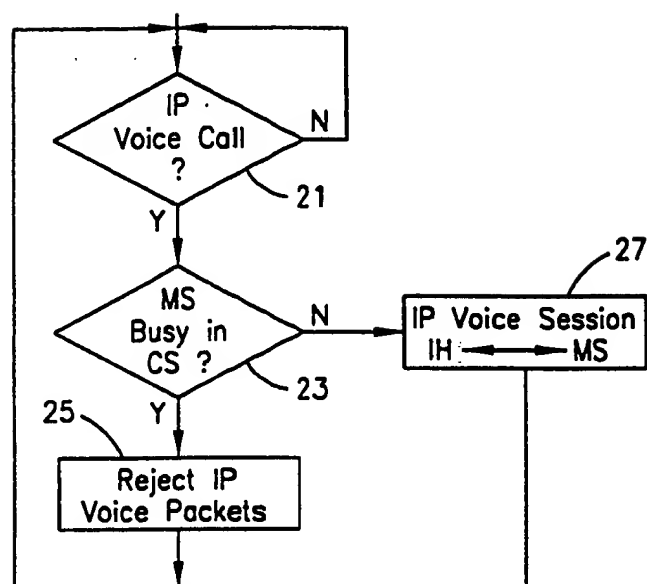


FIG. 2
(PRIOR ART)

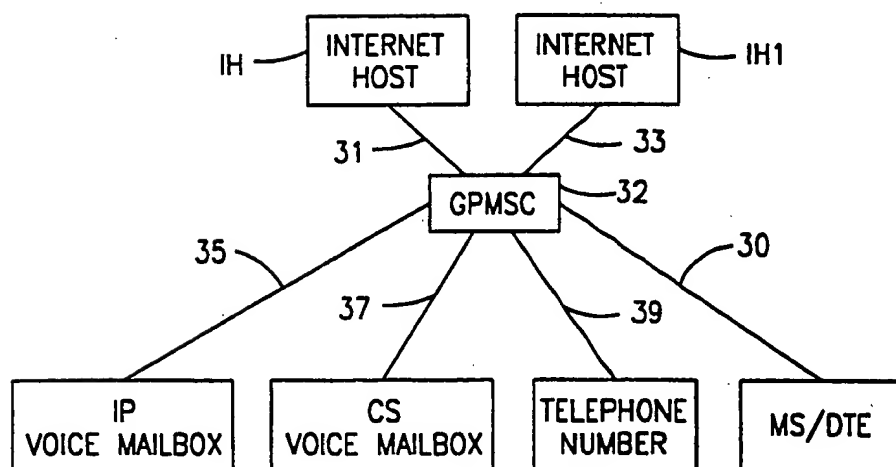


FIG. 3

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FIG. 4

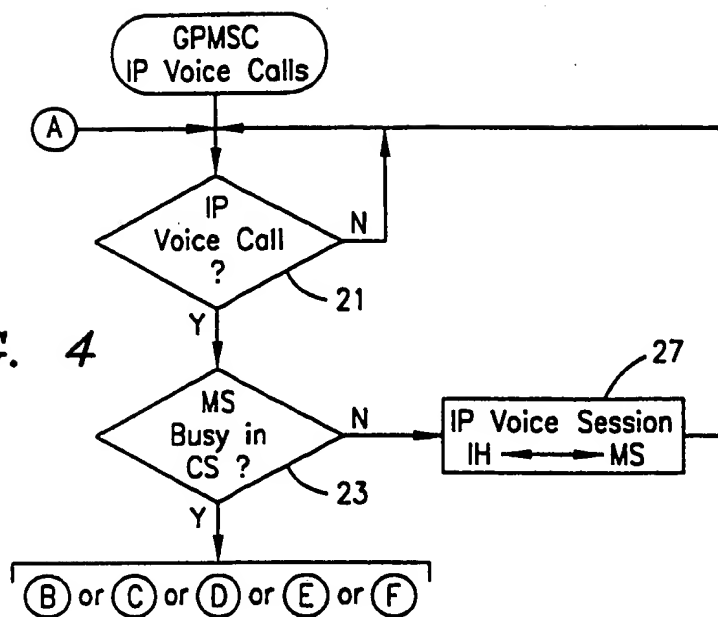
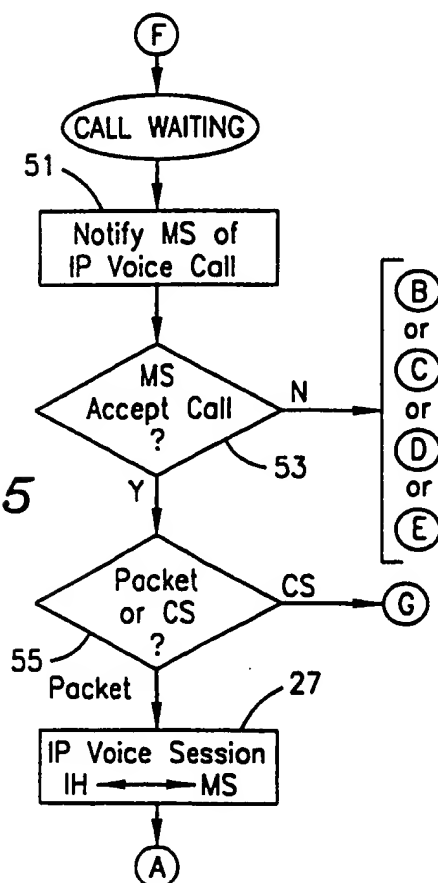
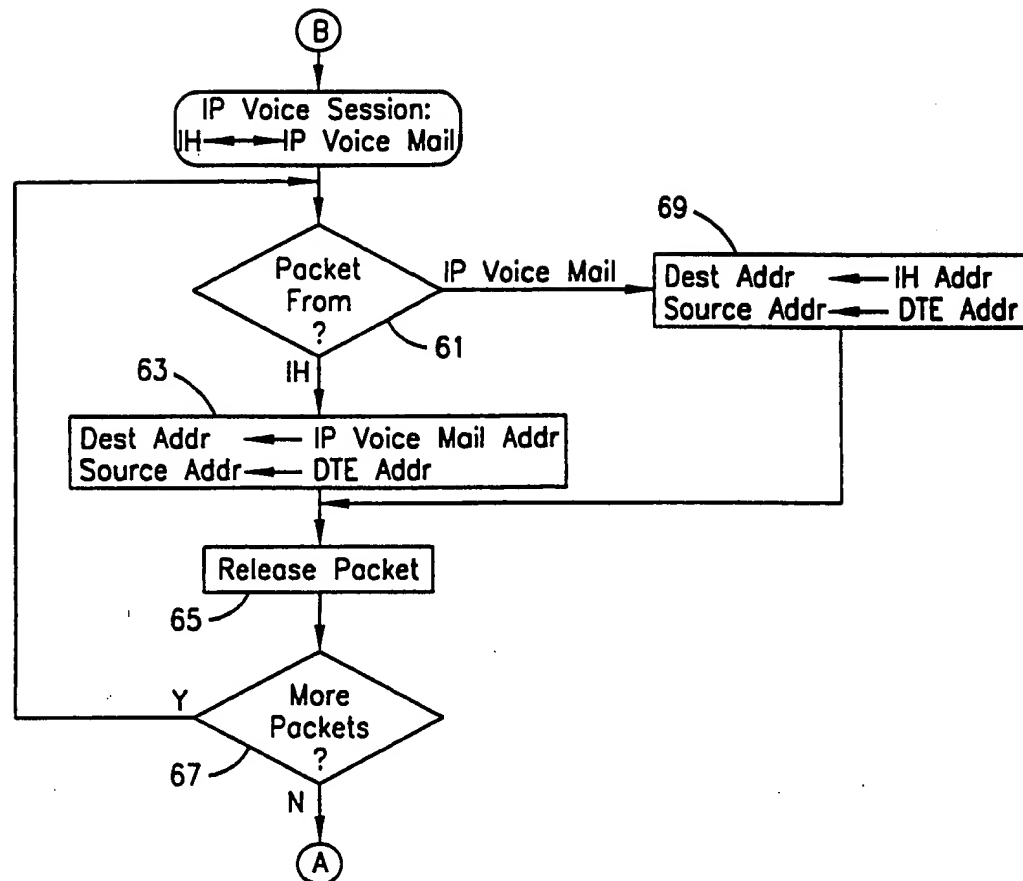


FIG. 5



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**FIG. 6**

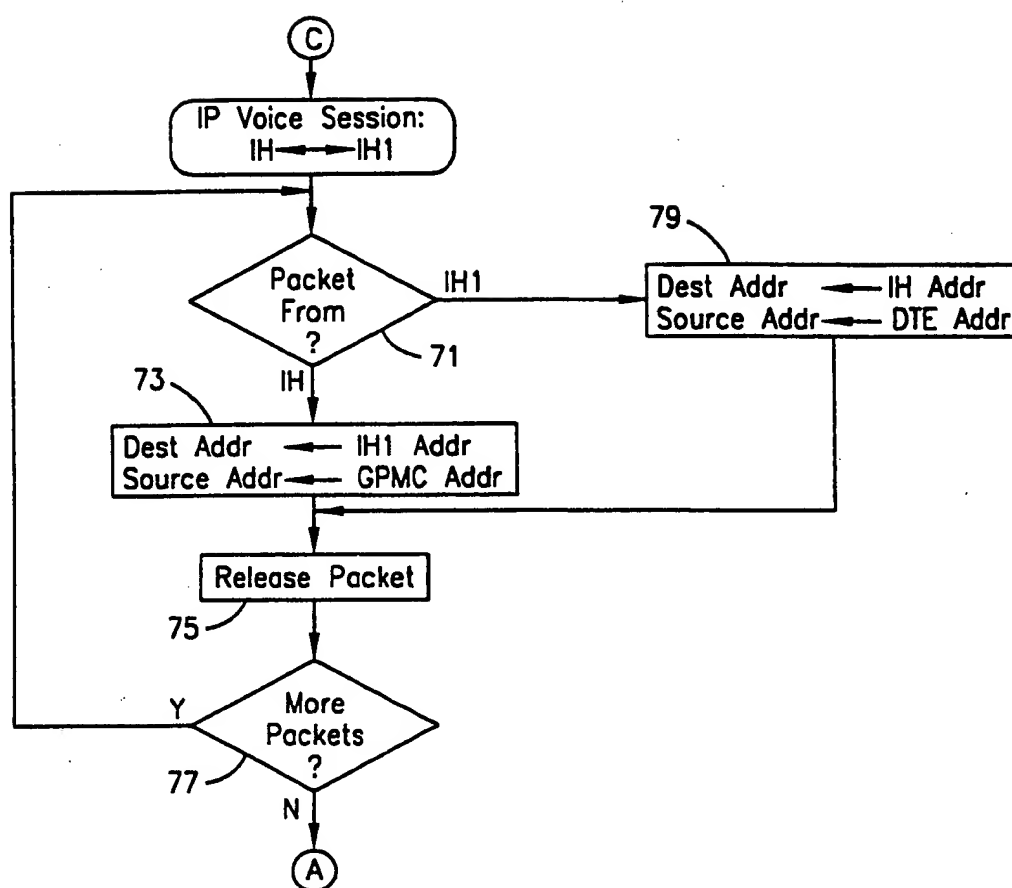


FIG. 7

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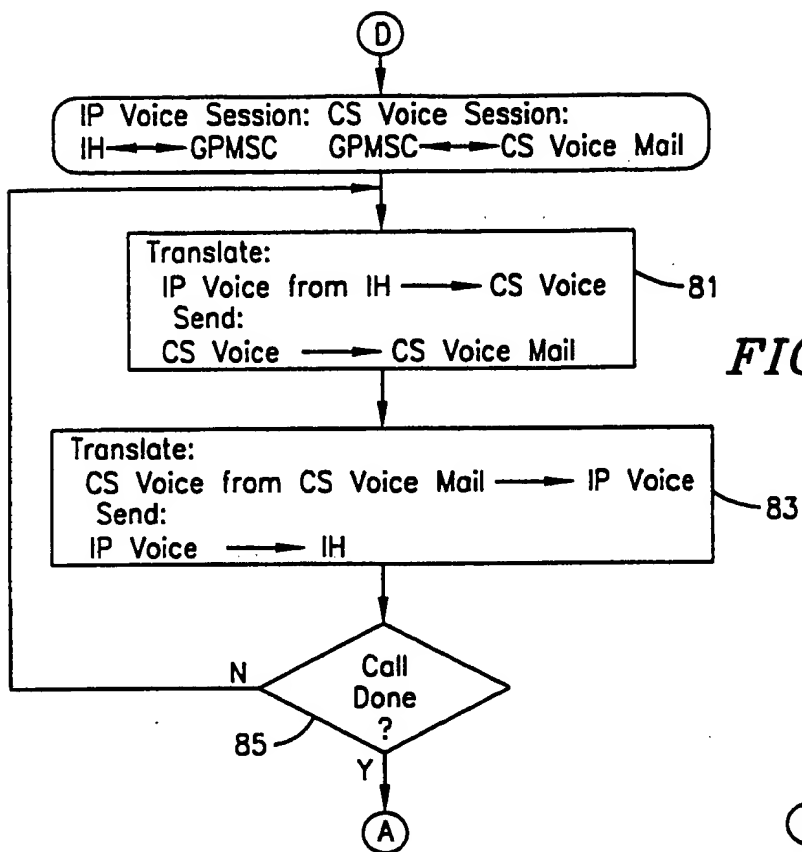
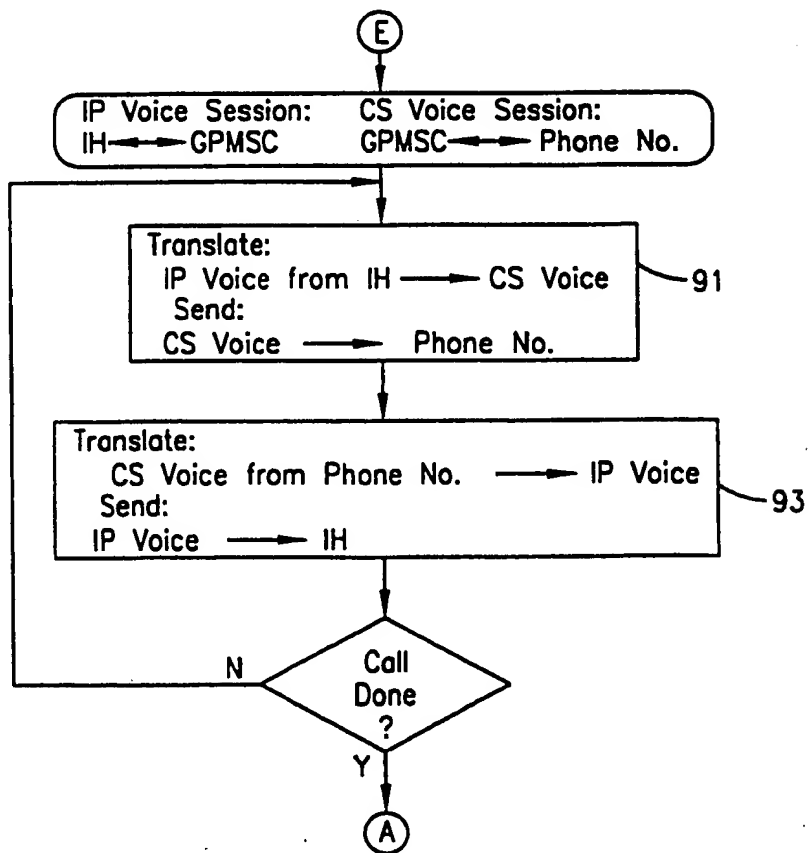
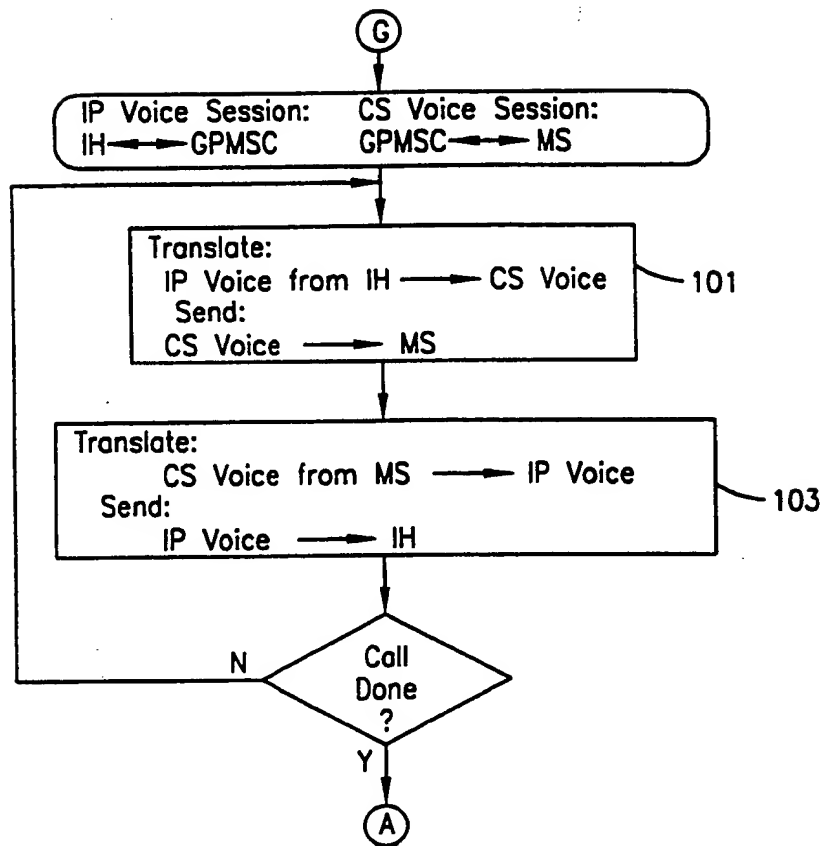


FIG. 9



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**FIG. 10**

INTERNATIONAL SEARCH REPORT

International Application No
PC1/SE 99/00185

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04M7/00 H04Q7/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04M H04Q H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| X | EP 0 758 175 A (NIPPON TELEGRAPH & TELEPHONE) 12 February 1997 see abstract see page 14, column 25, line 10 - page 15, column 28, line 56 see figure 13 --- | 1,2,26, 30,31, 37,39 |
| A | US H1641 H (SHARMAN DUANE R) 1 April 1997 see the whole document --- | 1-40 |
| A | US 5 327 486 A (KRAMER MICHAEL ET AL) 5 July 1994 see abstract see figures 2,3 --- | 1-40 |
| | -/-- | |

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Date of the actual completion of the international search

7 June 1999

Date of mailing of the international search report

16/06/1999

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INTERNATIONAL SEARCH REPORT

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| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| A | WO 97 26764 A (NOKIA TELECOMMUNICATIONS OY ;KARI HANNU H (FI); HUOTARI SEPPO (FI)) 24 July 1997 see page 14, line 6 - page 15, line 15 ----- | 1-40 |
| A | EP 0 750 439 A (NIPPON TELEGRAPH & TELEPHONE) 27 December 1996 see the whole document ----- | 1-40 |

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/SE 99/00185

| Patent document cited in search report | | Publication date | Patent family member(s) | | Publication date |
|-------------------------------------------|---|---------------------|----------------------------|-------------|---------------------|
| EP 0758175 | A | 12-02-1997 | WO | 9621308 A | 11-07-1996 |
| US H1641 | H | 01-04-1997 | CA | 2131349 A | 31-05-1995 |
| US 5327486 | A | 05-07-1994 | CA | 2158833 A,C | 29-09-1994 |
| | | | EP | 0691061 A | 10-01-1996 |
| | | | JP | 8508148 T | 27-08-1996 |
| | | | WO | 9422259 A | 29-09-1994 |
| WO 9726764 | A | 24-07-1997 | FI | 960211 A | 17-07-1997 |
| | | | AU | 1445997 A | 11-08-1997 |
| EP 0750439 | A | 27-12-1996 | US | 5867779 A | 02-02-1999 |
| | | | WO | 9621331 A | 11-07-1996 |